
January 11, 2022

RA-21-03653

U.S. Department of Transportation
Docket Operations
1200 New Jersey Avenue SE
West Building Ground Floor, Room W12-140
Washington DC 20590

Subject: Submittal of revised "Statement of No Adverse Effect on Safety" in support of "Petition for Time-limited, Partial Exemption from Title 14 Code of Federal Regulations Sections 25.901(c), and Part 25 Appendix K, K25.1.1 for Fan Blade Out Failure"

Model: 737-600/-700/-700C/-800/-900/-900ER

Reference:

- a) Boeing Letter RA-21-02198, "Petition for Time-limited, Partial Exemption from Title 14 Code of Federal Regulations sections 25.901(c), and Part 25 Appendix K, K25.1.1 with respect to fan blade out failure", dated August 4, 2021
- b) Boeing Letter RA-21-02253, "Replacement of Docket Document ID# FAA-2021-0681-001 with corrected document", dated August 12, 2021

This letter is to submit: Updated "Statement of No Adverse Effect on Safety" in Reference (b) in support of the requested Time-Limited Exemption (Docket ID# FAA-2021-0681).

The Boeing Company submitted "Petition for Time-limited, Partial Exemption from Title 14 Code of Federal Regulations Sections 25.901(c), and Part 25 Appendix K, K25.1.1 for Fan Blade Out Failure" per reference (a), and resubmitted the petition per reference (b).

The Boeing Company provides the following supplement to the reference (b) in the form of a revised "Description of Issue" and "Statement of No Adverse Effect on Safety".

Description of Issue

Recent FBO Events:

Two CFM56-7B powered Next-Generation (NG) 737 airplanes experienced Fan Blade Out (FBO) events in-flight that led to an unexpected departure of nacelle structure:

- August 27, 2016, Pensacola, FL – portions of the inlet structure of engine position 1 departed



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- April 17, 2018, Philadelphia, PA – portions of the inlet and fan cowl structure of engine position 1 departed

These events have been the subject of formal investigation by the responsible regulatory agencies, leading to the following National Transportation Safety Board (NTSB) reports:

- Pensacola event: March 30, 2020 - DCA16FA217
- Philadelphia event: December 12, 2019 - DCA18MA142

Root cause corrective action (RCCA) activities from the events has identified previously unforeseen FBO event vulnerabilities for the inlet, fan cowl, fan cowl support beam, and exhaust nozzle. In July 2020, the Federal Aviation Administration (FAA) provided clarification regarding 14 CFR 25.901(c) compliance expectations for unsecured nacelle components as a result of the recent FBO events. All of the identified vulnerabilities must be addressed in order to restore full compliance to 14 CFR 25.901(c) and the latest regulatory expectations. Additionally, compliance to 14 CR 25.901(c) is required to support compliance to K25.1.1.

Boeing has been pursuing a multi-phased solution to return the 737 NG Fleet nacelle design to a compliant state for FBO events.

Safety actions involving fan blade inspections and life limits were previously implemented to ensure continued airworthiness and minimize the likelihood of a FBO event.

Design modifications have been identified for the vulnerabilities listed above. Incorporation of these modifications into the fleet requires a time-limited exemption. Once these modifications are incorporated, full compliance will be restored.

Additional details are provided below for each of these phases for the 737 NG airplanes powered by CFM56-7B engines.

FBO Continued Airworthiness:

Boeing and CFM have previously identified inspections and blade replacement requirements for the CFM56-7B powered 737NG fleet that addressed the current known root cause failure of the fan blade out (FBO) events and established a level of safety that met the FAA continued airworthiness requirements.

- In 2018, CFM made fan blade inspection (initial & recurring inspection) and replacement service bulletins available to the fleet. The FAA mandated these inspections via an AD.
- In 2019, CFM released a service bulletin recommending a life limit on the fan blades and removal of blades from service.

These bulletins have proven highly effective in establishing and maintaining an acceptable level of safety for the flying 737NG fleet, with over 58 million flight cycles since mandate of the inspection service bulletin and no fan blade failure events. The inspections themselves have shown a crack detection and blade removal rate of approximately 0.03%, which is well aligned with the predictions for the defined conservative inspection interval.



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FBO Related Enhancements:

In order to show and find full compliance with the regulations listed above for the FBO failure condition, in addition to the CFM56-7B fan blade inspection and life limited recommendation, Boeing will provide modifications to the following structures:

Inlet Modifications:

The inlet modifications will introduce a new spacer design and increased fastener capability to ensure the inlet will not depart during a FBO event. These modifications are ready to be released to the fleet now.

Fan Cowl and Fan Cowl Support Beam Modifications:

Fan cowl and fan cowl support beam modifications will be implemented to ensure nacelle retention in the event of an engine fan blade failure. These modifications are ready to be released to the fleet now.

Exhaust Nozzle Modifications:

The exhaust nozzle modifications will introduce additional structural stiffening elements to help the nozzle carry the FBO dynamic loads and to ensure that the nozzle will not depart during a FBO event. The modification design work is still underway and on track to be released to the fleet in 3Q22.

Statement of No Adverse Effect on Safety

Boeing uses an FAA-approved Safety Management System (SMS) to manage the CFM56-7B powered 737NG fleet and ensure the highest levels of safety. Boeing's SMS process has identified a set of modifications that address all known root causes of the relevant fan blade out (FBO) events and resulting impacts to the engine nacelle. The implementation of each modification, and the combination of modifications proposed for certification will reduce risk of an unsafe outcome as compared to the unmodified design.

As stated above, the primary FBO root cause driver (fan-blade root failure) has been addressed by the implementation of fan blade inspection, and life limit of blade service bulletins. The 737NG CFM56-7B fleet has flown over 58 million flight cycles since mandate of the inspection service bulletin with no fan blade failure events.

Over the time period requested for partial exemption, the risk of a FBO-related unsafe condition occurring within the fleet with the improved engine fan blade inspection methods and inspection intervals is extremely improbable. The inspection methods and intervals developed by CFM and independently validated by Boeing, the FAA, and other industry experts are in place to reliably detect fan blade root cracks prior to failure. The risk of an unsafe condition arising over the requested partial exemption interval is extremely improbable.

Boeing will utilize the temporary exemption to certify and release incremental type design changes via service bulletins to further enhance the safety of the inlet, fan cowl, fan cowl support beam and exhaust nozzle structures and restore full compliance upon installation of all design changes under this exemption. The incremental release of these type design changes



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will allow the 737NG fleet operators (~7000 airplanes) to incorporate the changes as soon as they become available. In addition, for any future modifications, Boeing will ensure that each proposed modification or set of modifications does not have an adverse effect on safety as part of the Type Design Change.

The planned modifications are currently anticipated to include:

Fan Cowl, Fan Cowl Support Beam, Inlet and Exhaust Nozzle

Fan cowl, fan cowl support beam, inlet and exhaust nozzle modifications will be implemented to ensure retention in the event of an engine fan blade failure. Implementation of the inlet modification will ensure the retention of the inlet and the ability for the airplane to achieve maximum ETOPS diversion time (per 14 CFR Part 25, appendix K25.1.1). Retention of the fan cowl, fan cowl support beam and exhaust nozzle have no significant impact on the ability for the airplane to achieve maximum ETOPS diversion time.

Upon completion of the certification and installation of these modifications, the propulsion system installation will be fully compliant to 14 CFR §§ 25.901(c) and appendix K25.1.1 to 14 CFR Part 25.

Through its Safety Management System and ongoing coordination with the FAA, Boeing will continue to monitor the 737NG fleet to ensure that it meets FAA standards for continued airworthiness. Boeing is committed to designing, certifying, and manufacturing all changes required for a full showing of compliance within the proposed time-limited partial exemption period.

Sincerely,

A handwritten signature in dark ink, appearing to read "Rich Ptacin", written in a cursive style.

Rich Ptacin
737 Chief Project Engineer
The Boeing Company
P.O. Box 3707 MC 98-121
Seattle, WA 98124-2207